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## AGRICULTURAL NOTES

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### THE MOSQUITOES OF PUERTO RICO AND THEIR RELATION TO HUMAN WELFARE

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#### THE MOSQUITO PROBLEM

#### MOSQUITOES ARE A VITAL FACTOR AFFECTING HUMAN WELFARE IN PUERTO RICO:

THE MOSQUITO SPECIES PRESENT IN PUERTO RICO INCLUDE SEVERAL WHICH VITALLY AFFECT HUMAN WELFARE, SINCE AMONG THEM ARE THE CARRIERS OF AT LEAST FOUR SERIOUS DISEASES OF MAN, NAMELY, MALARIA, YELLOW FEVER, FILARIASIS, AND DENGUE. ALL OF THE BITING MOSQUITOES ALSO CAUSE A SERIOUS DISCOMFORT TO HUMAN BEINGS. THE GEOGRAPHIC POSITION OF PUERTO RICO IS SUCH THAT CLIMATIC CONDITIONS FAVOR THE DEVELOPMENT OF MOSQUITOES THROUGHOUT THE ENTIRE YEAR. THE GENERAL MOSQUITO PROBLEM OF PUERTO RICO IS THEREFORE OF A GREATER MAGNITUDE THAN THAT OF COUNTRIES IN ZONES OF LOWER TEMPERATURES WHERE MOSQUITOES ARE ACTIVE DURING ONLY A PORTION OF THE YEAR.

THE PURPOSE OF THESE NOTES IS TO GIVE A GENERAL ACCOUNT OF THE LIFE HISTORIES AND HABITS OF THOSE PUERTO RICAN MOSQUITOES WHICH ARE MOST IMPORTANT AS CARRIERS OF DISEASE AND AS CAUSES OF DISCOMFORT IN THE EVERYDAY LIFE OF HUMAN BEINGS, AND TO INDICATE HOW THEY MAY BE CONTROLLED. THEY ARE BASED ON STUDIES CARRIED ON BY THE WRITER FROM JULY 1935 TO JUNE 1936 WHILE ENGAGED IN INVESTIGATIONS ON MOSQUITOES IN PUERTO RICO FINANCED INITIALLY FROM FUNDS ALLOTTED TO THE BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE UNDER PUERTO RICO (SUGAR PROCESSING) TAX FUND ORDER NUMBER 2.

#### LIFE HISTORY AND HABITS OF THE MOSQUITO

#### THE MOSQUITO PASSES THROUGH FOUR STAGES:

A MOSQUITO PASSES THROUGH THE FOLLOWING FOUR STAGES IN ITS DEVELOPMENT, EGG, LARVA OR WRIGGLER, PUPA, AND ADULT; THESE STAGES ARE ILLUSTRATED IN FIGURES 1 TO 5 ON PAGE 6. THE EGGS ARE MINUTE IN SIZE AND USUALLY DARK BROWN OR BLACK IN COLOR. THEY MAY BE LAID SINGLY, IN CLUSTERS, OR IN CLOSELY COMPACTED "RAFTS" OF AS MANY AS 100 TO 200







INDIVIDUALS. IN SOME SPECIES THEY ARE DEPOSITED ON THE SURFACE OF THE WATER WHILE IN OTHERS THEY ARE LAID NEAR BUT JUST ABOVE THE WATER LEVEL. IN ORDER FOR THE EGG TO DEVELOP, WATER MUST BE PRESENT. ACCORDINGLY THE EGGS OF SOME SPECIES WHICH ARE NOT LAID DIRECTLY ON THE SURFACE OF WATER MAY REMAIN DORMANT FOR SIX MONTHS TO A YEAR AND POSSIBLY LONGER. IN NORTHERN CLIMATES MANY MOSQUITOES PASS THE WINTER SEASON IN THIS STAGE AND ALTHOUGH THE EGG MAY BE FROZEN OR DRIED IT WILL HATCH WITH THE RETURN OF SUITABLE TEMPERATURES AND THE FLOODING OF ITS RESTING PLACE WITH WATER. UNDER FAVORABLE CONDITIONS THE EGG STAGE IS SHORT IN DURATION, SOMETIMES BUT TWO OR THREE DAYS, AFTER WHICH THE CAP OF THE EGG IS PUSHED BACK AND THE SMALL LARVA EMERGES AND SWIMS FREELY IN THE WATER.

THE LARVAL STAGE MAY BE AS SHORT AS SIX DAYS:

THE LARVAL STAGE, ALWAYS AQUATIC, MAY BE AS SHORT AS SIX DAYS UNDER FAVORABLE CONDITIONS OF TEMPERATURE AND FOOD, AND DURING THIS TIME THE LARVA CASTS ITS SKIN THREE TIMES. THE MATURE LARVA IS SLIGHTLY MORE THAN ONE-HALF INCH LONG AND ITS BODY IS DIVIDED INTO THREE REGIONS, HEAD, THORAX, AND ABDOMEN. THE HEAD BEARS A PAIR OF EYES, A PAIR OF ANTENNAE, AND ROTARY MOUTH BRUSHES. THE THORAX IS SHORT BUT IS WIDER THAN THE HEAD IN FRONT OF IT OR THE ABDOMEN BEHIND IT. IT BEARS NUMEROUS TUFTS OVER ITS SURFACE. THE ABDOMEN IS A LONG SLENDER PORTION COMPOSED OF NINE SEGMENTS, THE FIRST EIGHT OF WHICH BEAR TUFTS OF BRISTLES CALLED THE ABDOMINAL TUFTS. ON THE UPPER SURFACE OF THE EIGHTH SEGMENT THERE IS A PROCESS KNOWN AS THE SIPHON WHICH VARIES IN LENGTH AND SHAPE AS BETWEEN DIFFERENT SPECIES OF MOSQUITOES. THIS SIPHON, OR BREATHING TUBE, IS USED TO PIERCE THE SURFACE FILM OF WATER AND ALLOWS THE LARVA TO BREATHE ATMOSPHERIC AIR.

IN MOST MOSQUITOES THE LARVAE, WHILE TAKING IN AIR THROUGH THE SIPHON, HANG AT AN ANGLE WITH THE WATER SURFACE, WITH THE HEAD DOWNWARD. IN THE GROUP TO WHICH THE MALARIA MOSQUITO BELONGS, HOWEVER, THE BODY IS HELD PARALLEL TO THE SURFACE OF THE WATER; THIS POSITION, TAKEN WHILE BREATHING AND FEEDING, ENABLES ONE TO DISTINGUISH THE LARVAE OF MALARIA MOSQUITOES FROM OTHERS AT A GLANCE. IN ORDER FOR THE LARVA TO TAKE ATMOSPHERIC AIR THROUGH THE SIPHON THE WATER MUST BE PRACTICALLY MOTIONLESS. ACCORDINGLY, LARVAE ARE FOUND ONLY IN COMPARATIVELY STILL WATERS. IN ONE GROUP OF MOSQUITOES OF WHICH REPRESENTATIVES OCCUR IN PUERTO RICO THE SIPHON IS USED TO PIERCE THE ROOTS AND STEMS OF CERTAIN PLANTS AND TO WITHDRAW AIR FROM THE SPACES WITHIN THE PLANT.

THE NINTH SEGMENT OF THE LARVA IS SMALL AND BEARS AT ITS OUTER END THE ANAL OPENING AND A SET OF TRACHEAL GILLS. THE TRACHEAL GILLS ENABLE THE LARVA TO TAKE AIR FROM THE WATER TO SUPPLEMENT THE SUPPLY OF ATMOSPHERIC AIR TAKEN IN THROUGH THE SIPHON.

THE MOSQUITO CANNOT TAKE IN FOOD DURING THE PUPAL STAGE:

THE PUPA - THE THIRD STAGE, STILL AQUATIC, IN THE LIFE HISTORY OF THE MOSQUITO - IS THE STAGE IN WHICH THE CHANGE TO A WINGED INSECT IS COMPLETED. IN SHAPE THE PUPA RESEMBLES AN ENLARGED COMMA. THE HEAD BEARS A PAIR OF BREATHING TUBES AND THE PUPA RESTS WITH ITS HEAD UPPERMOST. THE PUPA HAS NO MOUTH, THEREFORE IT CANNOT TAKE IN FOOD. THE PARTS OF THE FUTURE WINGED INSECT SUCH AS WINGS, ANTENNAE, ETC., CAN BE SEEN WITHIN THE SKIN OF THE PUPA. THE PUPAL STAGE IS SHORT, OFTEN ONLY TWO OR THREE DAYS IN LENGTH. AT THE END OF THIS TIME WHILE IT IS RESTING AT THE SURFACE OF THE WATER, A SLIT APPEARS ALONG ITS BACK AND THE ADULT MOSQUITO FORCES ITS WAY OUT, RESTS FOR A TIME UNTIL IT BECOMES DRY AND HAS SPREAD ITS WINGS AND THEN FLIES AWAY.







THE SEXES OF ADULT MOSQUITOES CAN BE EASILY RECOGNIZED:

THE ADULT MOSQUITO IS A SMALL INSECT AND, AS IN THE CASE OF THE LARVA, ITS BODY IS DIVIDED INTO THREE REGIONS, HEAD, THORAX, AND ABDOMEN. THE HEAD BEARS A PROMINENT BEAK, A PAIR OF PALPI LOCATED JUST ABOVE THE BEAK, A PAIR OF ANTENNAE AND A PAIR OF EYES. IN MALE MOSQUITOES THE ANTENNAE ARE MUCH MORE FEATHERY AND THE PALPI ARE USUALLY MUCH LARGER THAN IN THE FEMALES AND THE SEXES MAY BE READILY SEPARATED BY THESE CHARACTERS. THE THORAX BEARS THREE PAIRS OF LEGS BELOW AND ONE PAIR OF WINGS ABOVE. SMALL SCALES ARE TO BE FOUND ON THE THORAX, ADDOMEN, AND WINGS. ON THE WINGS THE SCALES ARE GENERALLY ATTACHED ALONG THE VEINS. THE SHAPE, COLOR, AND ARRANGEMENT OF THESE SCALES AID IN THE IDENTIFICATION OF THE ADULTS. THE ABDOMEN IS SLENDER AND SLIGHTLY LONGER THAN THE THORAX.

THE MATING OF MOSQUITOES USUALLY OCCURS DURING FLIGHT:

MOSQUITOES USUALLY MATE SHORTLY AFTER EMERGENCE. THE TIME OF DAY DURING WHICH MATING OCCURS VARIES WITH THE SPECIES, BUT IN MANY MOSQUITOES IT OCCURS DURING THE TWILIGHT PERIOD JUST AFTER SUNDOWN. AT THIS TIME THE MALES SWARM ABOUT IN LARGE NUMBERS AND THE FEMALES FLY INTO THE SWARM AND HERE MATING TAKES PLACE. THE PROCESS OF MATING REQUIRES BUT A FRACTION OF A MINUTE. ALTHOUGH A FEMALE USUALLY MATES WITH A MALE ONLY ONCE DURING HER LIFE, A MALE MAY MATE WITH MANY FEMALES IN RAPID SUCCESSION.

ONLY THE FEMALE MOSQUITO SUCKS BLOOD:

THE FOOD HABITS OF MOSQUITOES VARY WITH THE SPECIES AND THE SEXES. ALL MALE MOSQUITOES AND THE FEMALES OF SOME SPECIES SUBSIST ON PLANT JUICES. THE FEMALES OF MOST SPECIES, HOWEVER, PREFER BLOOD, EITHER FROM MAN OR OTHER WARM-BLOODED ANIMALS, AND IT APPEARS THAT USUALLY THE EGGS DO NOT DEVELOP UNTIL THE FEMALE HAS INGESTED BLOOD. IT IS THE BLOOD HUNGER OF THE FEMALE MOSQUITO WHICH MAKES IT A SERIOUS PEST SINCE, IN ADDITION TO THE ANNOYANCE CAUSED BY BITING, IT IS THE BLOOD-SUCKING HABIT WHICH IS RESPONSIBLE FOR THE SPREAD OF THE SEVERAL MOSQUITO-BORNE DISEASES IN PUERTO RICO.

THE BEAK OF THE FEMALE MOSQUITO IS A COMPLEX STRUCTURE COMPOSED OF MANY PARTS. WHEN THE HUMAN SKIN IS PIERCED BY THE BEAK THE MOSQUITO INJECTS A SMALL AMOUNT OF SALIVA WHICH PREVENTS THE VICTIM'S BLOOD FROM CLOTTING. AT THE SAME TIME DISEASE GERMS MAY BE PASSED INTO THE BLOOD STREAM IF THE MOSQUITO IS INFECTED WITH THEM. A SMALL PORTION OF THE VICTIM'S BLOOD IS THEN DRAWN INTO THE BODY OF THE MOSQUITO.

THE MOSQUITOES WHICH TRANSMIT HUMAN DISEASES IN PUERTO RICO

IN PUERTO RICO THERE ARE MORE THAN 35 SPECIES OF MOSQUITOES:

IN PUERTO RICO ALONE THERE ARE MORE THAN 35 SPECIES OF MOSQUITOES. OF THESE THERE ARE PROBABLY FROM 6 TO 8 SPECIES THAT DO NOT CAUSE ANY TROUBLE TO MAN, THE OTHERS BEING EITHER ANNOYERS OR DISEASE CARRIERS OR BOTH. THERE ARE 3 SPECIES WHICH ARE OF PARTICULAR IMPORTANCE, AND DESCRIPTIONS OF THESE FORMS FOLLOW.

THE TROPICAL HOUSE MOSQUITO IS USUALLY MORE ACTIVE AT NIGHT:

THE SO-CALLED TROPICAL HOUSE MOSQUITO, CULEX QUINQUEFASCIATUS, IS OF MEDIUM SIZE AND IS DEEP YELLOWISH TO DARK BROWN IN COLOR. THE LEGS AND BEAK HAVE NO MARKINGS





BUT THE ABDOMEN HAS A NARROW WHITISH BAND AT THE BASE OF EACH SEGMENT. THIS IS THE MOSQUITO MOST COMMONLY FOUND IN THE HOUSES OF PUERTO RICO. IT IS ACTIVE USUALLY AT NIGHT. DURING THE DAY THE FEMALES AS WELL AS THE MALES MAY BE FOUND IN HOUSES, RESTING IN CLOTHES CLOSETS. AT NIGHT THE FEMALES BECOME ACTIVE AND MAY BE FOUND IN NUMBERS WHERE PEOPLE ARE SITTING OR ON THE NETS OF BEDS IN WHICH PEOPLE ARE SLEEPING.

THE FEMALE OF THIS SPECIES LAYS ITS EGGS IN RAFTS OF 100 TO 200 ON THE SURFACE OF STAGNANT WATER. SUITABLE BREEDING PLACES ARE STREET GUTTERS, TIN CANS, DRAINAGE DITCHES, POOLS AROUND HOUSES, AND SUCH PLACES. THIS MOSQUITO APPEARS TO PREFER DIRTY WATER, AND THOUSANDS OF LARVAE MAY BE FOUND DEVELOPING IN DIRTY WASTE WATER FROM HOUSES. THE LARVA HAS A BREATHING TUBE WHICH IS SLIGHTLY LARGER IN THE CENTER THAN AT EITHER END, A CHARACTER THAT IS USEFUL IN ITS IDENTIFICATION. THE PUPA CANNOT BE READILY DISTINGUISHED FROM THAT OF OTHER MOSQUITOES.

DURING THE RAINY SEASON IN PUERTO RICO THE STREET GUTTERS AND OTHER SUITABLE BREEDING PLACES OF THIS MOSQUITO ARE FLUSHED OUT BY THE DAILY RAINS AND CONSEQUENTLY MANY OF THE LARVAE ARE DESTROYED. DURING THE DRY SEASON CONDITIONS ARE BETTER FOR THE DEVELOPMENT OF THE LARVAE AND CONSEQUENTLY THE HOUSE MOSQUITOES INCREASE TO GREAT NUMBERS.

THE TROPICAL HOUSE MOSQUITO IS THE CARRIER OF FILARIASIS:

THE TROPICAL HOUSE MOSQUITO IS PROBABLY MOST IMPORTANT AS AN ANNOYER, YET IT ALSO IS THE INTERMEDIATE HOST AND CARRIER OF A PARASITE OF HUMAN BEINGS. THE DISEASE KNOWN AS FILARIASIS IS CAUSED BY A SMALL WORM-LIKE MICRO-ORGANISM WHICH LODGES IN THE LYMPH CANALS OF MAN, USUALLY IN THE LOWER PELVIC REGION. THE RESULTING CLOGGING OF THE LYMPH CANALS CAUSES AN ACCUMULATION OF A LARGE AMOUNT OF LIQUID IN VARIOUS PORTIONS OF THE BODY. THE SWOLLEN LEGS IN MEN AND WOMEN, THE SWOLLEN SCROTA OF MEN, AND THE ENLARGED BREASTS OF MEN AND WOMEN ARE INDICATIONS OF THE PRESENCE OF FILARIAL BODIES WHICH HAVE CLOGGED CERTAIN LYMPH CANALS AND CAUSED AN ACCUMULATION OF LYMPH, RESULTING IN THE ENLARGEMENT OF A REGION OF THE BODY.

THE FILARIAE WHICH ARE LODGED IN THE LYMPH CANALS GIVE OFF VAST NUMBERS OF MINUTE ORGANISMS, KNOWN AS MICROFILARIAE, WHICH FIND THEIR WAY INTO THE PERIPHERAL BLOOD SYSTEM DURING THE NIGHT. WHEN A MOSQUITO BITES A PERSON HAVING FILARIASIS THESE MICROFILARIAE ARE TAKEN INTO THE BODY OF THE MOSQUITO. WITHIN THE MOSQUITO THE MICROFILARIAE UNDERGO CERTAIN CHANGES AND THEN PASS FORWARD TO THE BEAK OF THE MOSQUITO. WHEN THE MOSQUITO BITES ANOTHER PERSON THESE TRANSFORMED MICROFILARIAE PASS TO THE NEW HOST THROUGH THE OPENING MADE BY THE MOSQUITO, GAIN ACCESS TO A LYMPH CANAL AND DEVELOP TO MATURITY. AS THEY INCREASE IN SIZE THEY BLOCK THE PASSAGE AND CONSEQUENTLY AN ACCUMULATION OF LYMPH TAKES PLACE RESULTING IN THE ENLARGEMENT OF A PORTION OF THE INFECTED HUMAN BODY.

THE TROPICAL HOUSE MOSQUITO CAN BEST BE CONTROLLED BY ELIMINATING ALL STANDING WATER FOUND IN THE NEIGHBORHOOD OF HOUSES. STREET GUTTERS SHOULD BE KEPT CLEAN FROM RUBBISH. TIN CANS AND OTHER VESSELS SHOULD BE PLACED SO AS NOT TO COLLECT WATER. DRAINAGE DITCHES SHOULD BE DEEP AND NARROW AND HAVE SUFFICIENT DROP TO ALLOW CONSTANT MOVEMENT OF THE WATER.

AEDES AEGYPTI, CALLED THE "DAY MOSQUITO", IS CARRIER OF YELLOW FEVER AND DENGUE:

THE YELLOW-FEVER MOSQUITO, AEDES AEGYPTI, IS SMALLER IN SIZE THAN THE TROPICAL HOUSE MOSQUITO AND HAS CONSPICUOUS AND BEAUTIFUL MARKINGS. ITS GENERAL COLOR IS BLACK,







BUT ITS THORAX IS MARKED WITH A SILVERY WHITE, LYRE-SHAPED PATTERN. THE ABDOMEN IS BANDED WITH SILVERY WHITE AND THE LEGS ARE BANDED ALTERNATELY WITH BLACK AND WHITE. BOTH MALE AND FEMALE OF THIS SPECIES ARE SHOWN IN FIGURES 4 AND 5 ON PAGE 6.

THIS MOSQUITO IS USUALLY FOUND ONLY NEAR DWELLINGS AND IT SHOWS A DECIDED PREFERENCE FOR HUMAN BLOOD. IT IS CALLED THE "DAY MOSQUITO" BECAUSE IT IS USUALLY ACTIVE AND BITES ONLY IN THE DAYTIME, ALTHOUGH IN THE PRESENCE OF LIGHT IT MAY ALSO BITE AT NIGHT. IT ATTACKS WITHOUT WARNING AND THE ANKLES AND UNDERSIDES OF WRISTS ARE FAVORITE PLACES OF ATTACK.

THE FEMALE DEPOSITS HER EGGS ON OR NEAR THE SURFACE OF WATER IN RAIN-WATER BARRELS, CISTERNS, AND SIMILAR RECEPTACLES. AN EGG OF THIS SPECIES IS SHOWN IN FIGURE 1 ON THE FOLLOWING PAGE. THE EGGS, IF LAID ON THE SURFACE OF THE WATER, HATCH IN ONE OR TWO DAYS AND THE LARVAE SECURE NOURISHMENT FROM THE ORGANIC SEDIMENT PRESENT IN THE CONTAINER AND UNDER FAVORABLE CONDITIONS DEVELOP TO MATURITY IN A FEW DAYS. THE PUPAL STAGE IS SHORT AND THE ADULT MOSQUITOES MAY EMERGE IN AS SHORT A PERIOD OF TIME AS SIX TO EIGHT DAYS AFTER THE EGGS ARE LAID. ILLUSTRATIONS OF BOTH LARVAL AND PUPAL STAGES ARE SHOWN IN FIGURES 2 AND 3.

THIS MOSQUITO IS THE CARRIER OF TWO DISEASES, YELLOW FEVER AND DENGUE OR BREAKBONE FEVER. FORTUNATELY, NO CASES OF YELLOW FEVER HAVE BEEN REPORTED IN PUERTO RICO SINCE THE AMERICAN OCCUPATION, ALTHOUGH PREVIOUS TO THAT THE DISEASE WAS COMMON AND AT TIMES EPIDEMIC. SINCE THE AMERICAN OCCUPATION SEVERAL CASES OF YELLOW FEVER HAVE BEEN REMOVED FROM VESSELS TO THE QUARANTINE STATION BY PUBLIC HEALTH DOCTORS INSPECTING INCOMING SHIPS. DENGUE, ALTHOUGH SELDOM FATAL, IS A SPECIFIC FEVER OF WARM COUNTRIES. FREQUENT CASES OF DENGUE ARE REPORTED IN PUERTO RICO.

THE RESTRICTED BREEDING HABIT OF THIS MOSQUITO MAKES ITS CONTROL A COMPARATIVELY SIMPLE MATTER. IT MAY BE CONTROLLED BY COVERING ITS BREEDING PLACES SUCH AS BARRELS, CISTERNS, AND SUCH RECEPTACLES, WITH FINE SCREENING, 18 WIRES TO THE INCH OR MORE, OR WITH TIGHT COVERS TO PREVENT THE FEMALE FROM REACHING TO OR NEAR THE SURFACE OF THE WATER TO DEPOSIT HER EGGS.

THE MALARIA MOSQUITO IS THE MOST IMPORTANT MOSQUITO IN PUERTO RICO:

ALTHOUGH THREE OR FOUR SPECIES OF MOSQUITOES ARE ASSOCIATED WITH MALARIA IN PUERTO RICO, ONLY ONE, KNOWN AS ANOPHELES ALBIMANUS, IS OF GREAT IMPORTANCE. THIS SPECIES MAY BE RECOGNIZED BY THE BLACK AND GOLD MARKING ON THE WINGS AND BY THE WHITE MARKING ON THE HIND PAIR OF LEGS. IN SIZE IT IS SLIGHTLY LARGER THAN EITHER OF THE TWO SPECIES WHICH HAVE BEEN DISCUSSED. THE FEMALES ARE ACTIVE ONLY AT NIGHT AND ARE EXTREMELY DIFFICULT TO LOCATE DURING THE DAY.

THE EGGS OF ANOPHELES ALBIMANUS ARE LAID SINGLY ON CLEAN WATER WHICH USUALLY CONTAINS SOME PLANT LIFE. SLOWLY-MOVING STREAMS, IRRIGATION DITCHES, OVERNIGHT RESERVOIRS, AND ROADSIDE DITCHES ARE SUITABLE PLACES FOR THE DEVELOPMENT OF THE LARVAE. THE LARVAE OF THIS SPECIES ARE FOUND IN ALL PARTS OF THE COASTAL PLAINS OF PUERTO RICO; ITS RATHER GENERAL DISTRIBUTION IN THESE THICKLY SETTLED PORTIONS OF THE ISLAND, TOGETHER WITH THE FACT THAT IT IS THE MOST IMPORTANT CARRIER OF MALARIA IN PUERTO RICO, MAKES IT A SERIOUS ECONOMIC PEST.

THE MICRO-ORGANISM DIRECTLY RESPONSIBLE FOR THE DISEASE MALARIA IS A SMALL ONE-CELLED PROTOZOAN. THE MOSQUITO IN ITS EFFORT TO OBTAIN FOOD SUCKS IN THIS CAUSATIVE





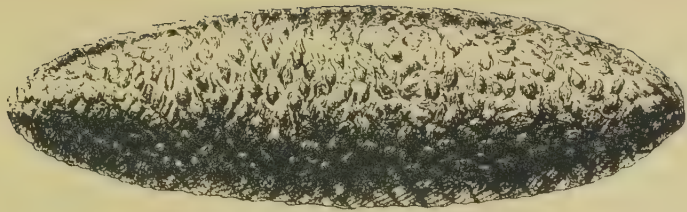


Fig. 1.-The egg of the yellow fever mosquito



Fig. 3.-Yellow fever mosquito pupa

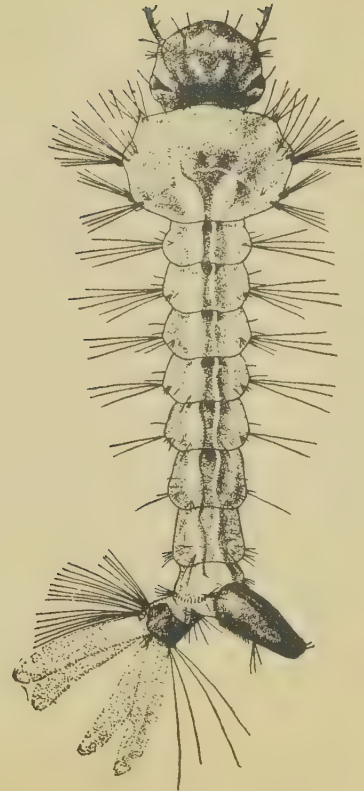


Fig. 2.-Yellow fever mosquito larva



Fig. 4.-Yellow fever mosquito-female



Fig. 5.-Yellow fever mosquito-male





ORGANISM ALONG WITH THE BLOOD OF THE MALARIOUS PERSON WHOM IT CHANCES TO BITE. THE ORGANISM UNDERGOES A SERIES OF GROWTH STAGES IN THE MOSQUITO. IT FINALLY DEVELOPS INTO A STAGE IN WHICH IT IS INJECTED ALONG WITH THE MOSQUITO'S SALIVA INTO THE WOUND OF THE PERSON BEING BITTEN. THE CAUSATIVE ORGANISM IS THUS INTRODUCED INTO THE BLOODSTREAM OF A PERSON WHERE IT MAY ATTACK THE RED BLOOD CORPUSCLES AND CAUSE THE CHILLS AND FEVER CHARACTERISTIC OF THE DISEASE.

MALARIA IS A GENERAL PROBLEM IN THE COASTAL PLAINS OF PUERTO RICO:

MALARIA IS A GENERAL PROBLEM IN ALL PARTS OF THE COASTAL PLAINS OF PUERTO RICO; IT IS A PARTICULARLY SERIOUS PROBLEM ALONG THE SOUTHERN COAST. IT IS ON THE COASTAL PLAINS OF PUERTO RICO THAT THE CULTIVATION OF SUGARCANE IS THE MAIN INDUSTRY. CONDITIONS SUITABLE FOR THE DEVELOPMENT OF THE LARVAE OF THIS SPECIES ARE FOUND IN THE IRRIGATION AND DRAINAGE DITCHES NECESSARY IN THE CULTIVATION OF THIS CROP. IN THE SOUTHERN COASTAL REGION THE LOW ANNUAL RAINFALL NECESSITATES THE USE OF IRRIGATION WATER, WHICH IS BROUGHT FROM THE NEARBY MOUNTAINS BY CANALS. FROM THE MAIN CANALS THE WATER IS TURNED INTO SMALLER IRRIGATION DITCHES AS NEEDED. IT IS IN THESE SMALLER DITCHES THAT FAVORABLE CONDITIONS FOR THE DEVELOPMENT OF LARVAE ARE FOUND.

IN SUGARCANE REGIONS OF THE ISLAND WHERE IRRIGATION IS NOT NECESSARY, DRAINAGE DITCHES PROVIDE SUITABLE BREEDING PLACES FOR THE LARVAE OF THE MALARIA MOSQUITO. THE HANDLING OF IRRIGATION WATER WITHIN THE SUGARCANE FIELDS SO THAT IT CANNOT STAY IN THE DITCHES LONGER THAN SIX DAYS AT ANY ONE TIME AND THE MAINTENANCE OF STRAIGHT-SIDED, GRASS-FREE MAIN IRRIGATION CANALS STOCKED WITH FISH, WOULD MATERIALLY AID IN REDUCING THE NUMBERS OF MALARIA MOSQUITOES IN THE SOUTHERN PORTION OF THE COASTAL PLAINS. IN THE OTHER SUGARCANE REGIONS THE PROPER HANDLING OF DRAINAGE WATERS BY THE USE OF STRAIGHT-SIDED, GRASS-FREE DITCHES WOULD ACCOMPLISH THE SAME END.

THE MOSQUITOES OF PUERTO RICO CAN BE CONTROLLED

ELIMINATION OF BREEDING PLACES IS FIRST STEP ESSENTIAL TO CONTROL MOSQUITOES:

A REDUCTION IN THE NUMBER OF MOSQUITOES CAN BE EFFECTED BY ELIMINATING THE PLACES IN WHICH THE LARVAE CAN DEVELOP. TWO OF THE MOST IMPORTANT SPECIES OF MOSQUITOES IN PUERTO RICO BREED ONLY IN THE STANDING WATER AROUND HOUSES. THEY CAN BE CONTROLLED WITH EASE IF NEIGHBORHOODS AND COMMUNITIES WILL COOPERATE IN CAMPAIGNS TO ELIMINATE STANDING WATER WHEREVER POSSIBLE. STREET GUTTERS AND CULVERTS SHOULD BE KEPT FREE OF TRASH AND RUBBISH SO THAT THE WATER WILL NOT BE OBSTRUCTED IN ITS FLOW. ALL TIN CANS AND SIMILAR RECEPTACLES SHOULD BE DISPOSED OF, OR HAVE HOLES PUNCHED IN THEM SO THAT THEY WILL NOT COLLECT WATER. THE WASTE WATER FROM HOUSES SHOULD BE EMPTIED DIRECTLY INTO DRAINAGE DITCHES OR CANALS RATHER THAN BEING THROWN INTO BACK YARDS, THERE TO PROVIDE SUITABLE PLACES FOR THE DEVELOPMENT OF LARVAE. THE DRAINAGE CANALS CARRYING WASTE WATERS FROM STREET GUTTERS AND HOUSES SHOULD BE NARROW AND STRAIGHT-SIDED AND HAVE SUFFICIENT GRADE TO INSURE CONSTANT MOVEMENT OF WATER THROUGH THEM. IN ADDITION, THESE DITCHES SHOULD BE KEPT CLEAN OF RUBBISH AND FREE FROM GRASS.

RAIN BARRELS AND CISTERNS SHOULD BE FITTED WITH TIGHT COVERS OR 18-MESH SCREENING IN ORDER TO PREVENT THE FEMALES FROM DEPOSITING THEIR EGGS IN THESE CONTAINERS. IN PLACES THAT IT IS NOT POSSIBLE TO SCREEN OR COVER, SUCH AS GARDEN POOLS, FISH -- PREFERABLY TOP-MINNOWS -- SHOULD BE INTRODUCED, SINCE THEY FEED ON THE LARVAE AND THEREDY EFFECT A CONSIDERABLE DEGREE OF CONTROL.





MUCH CAN BE DONE TO CONTROL THE MALARIA MOSQUITO BY THE PROPER HANDLING OF DRAINAGE AND IRRIGATION WATERS. THIS WORK IS RATHER LOW IN COST AND, SINCE LARGE CONCENTRATIONS OF PEOPLE ARE FOUND IN SUGARCANE AREAS, IT, NO DOUBT, WOULD MATERIALLY REDUCE THE NUMBERS OF MALARIA MOSQUITOES IN SUCH LOCALITIES. IN POOLS WHICH CANNOT BE DRAINED THE MOSQUITO LARVAE MAY BE DESTROYED BY APPLYING KEROSENE OIL AT THE RATE OF ONE OUNCE TO 15 SQUARE FEET OF WATER SURFACE. THIS TREATMENT MUST BE REPEATED, USUALLY EVERY TEN DAYS.

SIMPLE PRECAUTIONS TO AVOID BITING BY MOSQUITOES ARE IMPORTANT FACTOR IN PREVENTING MOSQUITO-CARRIED DISEASES:

PRECAUTIONS ALSO SHOULD BE TAKEN TO PREVENT MOSQUITOES FROM BITING PEOPLE. THIS IS PARTICULARLY IMPORTANT DURING THE SLEEPING HOURS, SINCE IT IS DURING THIS PERIOD THAT THE TROPICAL HOUSE AND MALARIA MOSQUITOES ARE ACTIVE. THE USE OF BED NETS IS THE MOST PRACTICABLE MEANS OF INSURING THIS PROTECTION. BED NETS SHOULD BE KEPT IN GOOD REPAIR AND WHEN IN USE THE LOWER EDGE SHOULD BE TUCKED UNDER THE MATTRESS. WELL CONSTRUCTED BUILDINGS SHOULD BE EQUIPPED WITH CLOSE-FITTING WINDOW AND DOOR SCREENS, BUT EVEN IN SCREENED HOUSES THE USE OF BED NETS IS ADVISABLE.

KEROSENE-PYRETHRUM EXTRACT SPRAYS OR FUMES FROM THE BURNING OF PYRETHRUM ARE USEFUL IN DESTROYING MOSQUITOES WHICH GAIN ENTRANCE TO SCREENED BUILDINGS.

